Treatment of Melasma by Low-fluence 1064nm Q-Switched Nd:YAG Laser: A Case Report

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Abstract

This severity of melasma, a common aesthetic issue, can range from a mild pigmentation during pregnancy that goes away on its own to a persistent, problematic, disfiguring condition. Melasma has a complex pathogenesis which is still unexplained. However, exposure to uv radiation and genetic or hormonal factors are important contributors. Since ultraviolet exposure has a well-known ability to stimulate proliferation of melanocytes, their migration and melagonesis, its exposure is a major triggering and exacerbating factor in the development of melasma. In melasma cases reported with usage of estrogen-progesterone oral contraceptives by mechanism of induction of melasma by estrogen may be related to the presence of estrogen receptors on the melanocytes that stimulate cells to produce more melanin. Clinical features of melasma are symmetry of hyperpigmentation and distribution related to trigeminal nerves, which suggest that neural involvement may play a role in pathogenesis of pigmentation. Clinically, melasma presents as a symmetrically distributed macular pigmentation with irregular borders, which can vary in color ranging from a light to dark, brown or brown, gray. The Melasma Area and Severity Index (MASI) used to assess melasma patients. There are numerous melasma treatment options available today, each with a varied success rate. Today, there are plenty of melasma treatments available, each with a different success rate. This article will discuss current advancements in low fluence 1064nm Q switched Nd:YAG laser melasma treatment and its implications for new therapeutic strategies.

Keywords: melasma, UV radiation, MASI, Nd:YAG laser therapy

This severity of melasma, a common aesthetic issue, can range from a mild pigmentation during pregnancy that goes away on its own to a persistent, problematic, disfiguring condition. It is an acquired increase in skin pigmentation that is characterised by symmetrical gray-brown patches, particularly on exposed skin [1].

Melasma has a complex pathogenesis which is still unexplained. However, exposure to uv radiation and genetic or hormonal factors are important contributors. Other potential causes of melasma include cosmetic ingredients, phototoxic and anti-seizure medications, endocrine diseases such as thyroid or ovarian malfunction, hepatic dysfunction, and nutritional deficiencies. It is significant to highlight that up to one-third of cases of melasma in women and the number of cases in men are idiopathic [1].

Since ultraviolet exposure has a well-known ability to stimulate proliferation of melanocytes, their migration and melagonesis, its exposure is a major triggering and exacerbating factor in the development of melasma [2]. Unlike melasma, UV-induced hyperpigmentation typically returns on its own, whereas melasma does not. Recently, Kim et al. discovered down regulation of the H19 gene on microarray analysis of hyperpigmented and normally pigmented skin in patients with melasma [3].

In melasma cases reported with usage of estrogen-progesterone oral contraceptives by mechanism of induction of melasma by estrogen may be related to the presence of estrogen receptors on the melanocytes that stimulate cells to produce more melanin [4]. Mild ovarian dysfunction may cause an idiopathic condition of melasma as Sawney and Anand found high prevalence of chronic inflammatory disease in women with melasma [5]. There are cases reported in men using estrogen derivatives for treatment of prostate cancer. However, many observations strongly suggest the role of genetic factors. familial occurrence of melasma has been reported to vary from 20-70% in different studies [6].

Clinical features of melasma are symmetry of hyperpigmentation and distribution related to trigeminal nerves, which suggest that neural involvement may play a role in pathogenesis of pigmentation [1]. Bak et al. (2009)[7] found higher level of neural endopeptidase in melasma lession and suggest that neuroactive molecules, including nerve growth factor, are critical factors for pathogenesis of melasma [7]. Human melanocytes may respond to angiogenic factors because normal human melanocytes express functiona; receptors for vascular endothelial growth factor (VEGF) [8]. In some type of melasma, a pronounced telangiectatic erythema confined to melasma-lesional skin has been observed. Besides neural factors and hormone receptors, blood vessels may play a role as major histologic findings in melasma showed increased vascularity.

Clinically, melasma presents as a symmetrically distributed macular pigmentation with irregular borders, which can vary in color ranging from a light to dark, brown or brown, gray [1]. Pigmentation may be guttate or confetti-like, linear, or confluent that evolved slowly over weeks or years and may fade in winter and get worse in summer. According to the distribution of lesions, there are three clinical patterns of melasma: centrofacial, malar and mandibular. There are 3 types of melasma: epidermal, dermal, and mixed types, depending on the level of increased melanin in the skin [1].

The Melasma Area and Severity Index (MASI) used to assess melasma patients with severity of melasma in each of the four regions; forehead, right and left malar region, chin, that based on three variables; percentage of the area involved (A), darkness (D), homogeneity (H) [1].

Today, there are plenty of melasma treatments available, each with a different success rate. A laser's efficiency is based on the

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theory of selective, which states that heating and injury are restricted to the target with less damage to the surrounding tissue when a specific wavelength of energy is delivered in a period of time shorter than the thermal relaxation time of the targeted chromophore. Thermal relaxation of melanosomes, time required for the target to cool to one-half of its peak temperature after laser light absorption, range from 50 nsec to 500nsec and the absorption spectrum of melanin is broad, therefore a variety of laser are accesible for removal of hyperpigmented spot. Short-pulsed high energy laser are the most commonly employed, including; the 510 nm pigmented lesion dye laser (PLDL), the Q- switched neodymium-yag (QS Nd: YAG) laser at 532nm and at 1064nm, the 694 nm Q-switched ruby laser (QSRL), and the 755 nm Q-switched alexandrite laser [9].

There is a growing need for an efficient melasma treatment due to modern lifestyles that include increased UV exposure, widespread use of hormones for contraception and hormone replacement therapy, as well as rising demands for aesthetics. The cornerstones of treatment are consistent use of sunscreen and topical medications that decrease melanogenesis.

This study covers recent advancement in understanding melasma pathophysiology and their implications for potential therapeutic approaches.

Case Presentation

A 28-year-old Malaysian woman of Malay ethnicity presented to our clinic with a 1-year history of hyperpigmentation on her face. Written consent was signed, provided that patient agreed to the use and analysis of her data. She came with complaint of discoloration of her face area. Physical examinations revealed multiple light to dark brown colored, irregularly shaped patches and macules with ill-defined margins on both malar areas, forehead and chin (Figure 1). There is history of using local products containing mercury for a year and patient claimed the hyperpigmentation started appearing soon after she stopped using the products. Patient work as a hawker and is always exposed to the sun and heat at work. Sunscreen application is not routinely done. There is no history of using any hormonal contraception and no significant family history of melasma. Based on the distribution of lesions, a clinical diagnosis of centrofacial melasma was made.

Management and Outcome

Patient was treated with 3 sessions of low-fluence 1064-nm Q-Switched Nd:YAG laser, using a 1064-nm wavelength setting, with a fluence of 1.5 to 2.0 J/cm2, pulse duration of 8 nanoseconds, and a 6-mm spot size. Treatments were repeated at 4-week intervals. The clinical endpoint for all three lasers was defined as mild erythema. Immediately after the procedures, the lesions were cooled with ice packs, and antibiotic ointment was applied to the irradiated area. Patient was advised to avoid sun exposure and apply a broad-spectrum sunscreen daily. There were no reported serious side effects during the course of the treatment. Digital photographs of the patient's face were taken at three different angles (frontal, right lateral, and left lateral) before initiating treatment and after completion of 3 sessions.

Follow-up assessment was done 1 month after the last treatment. As can be seen in [Figure 2], the hyperpigmented patches and macules have decreased significantly in size and intensity. To compare, pre- and post-treatment changes were analyzed using the Melasma Area and Severity Index score (MASI) in (Table 1) by reviewing patient's digital photographs before initiating the treatment and after completion of 3 treatments.

Patient is really satisfied with the outcome and rendered it successful in reducing her melasma.

Discussion

Our skin is made up of three layers. The outer layer is epidermis,the middle layer is dermis and the deepest layer is the subcutis. The epidermis

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layer contains cells called melanocytes that store and produce a dark colour (pigment) known as melanin. In response to light, heat or ultraviolet radiation or hormonal stimulation, the melanocyte produces more melanin.

Melasma (previously called chloasma) is a common acquired skin disorder that presents as a bilateral, asymptomatic, light-to-dark brown macules or patches with irregular borders. Melasma is more common in women than in men and onset is typically between the ages of 20 and 40 years old.

Melasma is more common in people who tan easily or have naturally brown skin. Common areas of melasma are on the cheeks, nose, chin, above the upper lip and the forehead. Occasionally it affects the arms, neck and back. In fact, melasma can affect any part of the skin that is exposed to sunlight.

Distinct patterns include:

- Centrofacial — forehead, cheeks, nose, upper lip (sparing the philtrum); 50-80% of presentations
- Malar — cheeks, nose
- Mandibular — jawline, chin
- Erythrosis pigmentosa faciei — reddened or inflamed
- Extrafacial — forearms, upper arms, shoulders in a sun-exposed distribution.

The cause of melasma is complex. It has been proposed to be a photoageing disorder in genetically predisposed individuals. The pigmentation results from the overproduction of melanin by melanocytes (pigment cells) which is either taken up by the keratinocytes (epidermal melanosis) and or deposited in the dermis (dermal melanosis, melanophages). Factors implicated in the development of melasma include family history, sun exposure, pregnancy, use of oral contraceptives, thyroid disorder, medications and scented products.

There are 3 types of melasma. The three types are epidermal, dermal, and mixed types, depending on the level of increased melanin in the skin.

1. Epidermal melasma is defined by dark brown, well-defined border, and appears more obvious under wood lamp. Dermoscopy will show scattered islands of brown reticular network with dark fine granules. Epidermal melasma usually has a good response.
2. Dermal melasma is defined by light brown to blue-grey, ill-defined border, no accentuation arciform structures. Dermal melasma usually has poor response.
3. Mixed melasma is the most common type, and is defined by combination of blue-grey, light and dark brown colour. Mixed patterns seen with Wood lamp and dermatoscope. Treatment usually shows partial improvement.

Melasma is usually a clinical diagnosis based on the clinical appearance, and examination with a Wood lamp and dermatoscope. Serial photography and severity indices such as the Melasma Area and Severity Index (MASI) or modified MASI was used to monitor response to treatment. The MASI value was calculated according to the following equation:

MASI = 0.3(DF+HF) AF + 0.3 (DMR+HMR) AMR + 0.3 (DML+HML) AML + 0.1 (DC+HC) AC

Where D is darkness, H is homogeneity, A is area, F is forehead, MR is right malar, ML is left malar, and C is chin. The MASI score for the patient was evaluated before and after treatment was taken. [9].

In this study, the patient showed improvement in MASI value after 3 sessions of low-fluence 1064-nm Q Switched Nd:YAG laser treatment. Melanocytes in melasma lesions are

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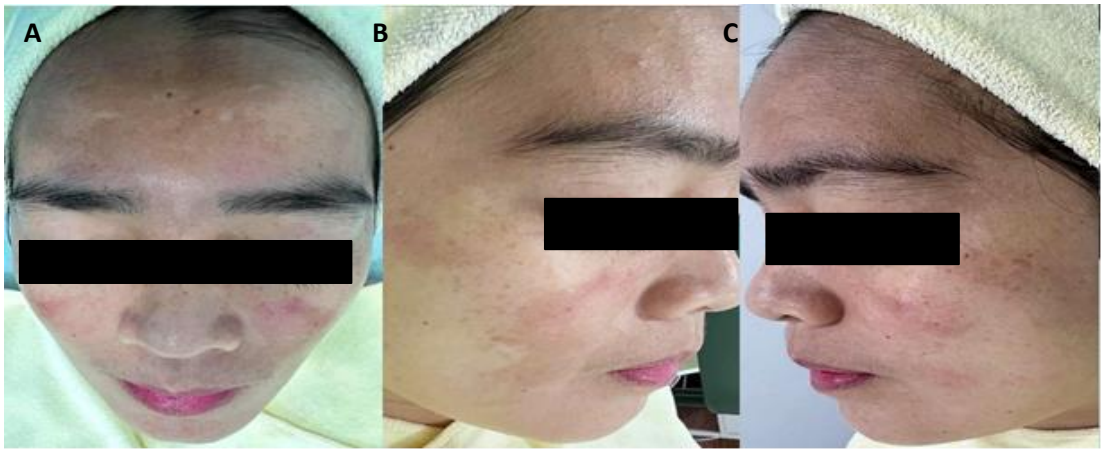

Figure 1: A 28-year-old female with centrofacial melasma. Pre-treatment photographs (A: frontal view, B: right lateral view, C: left lateral view)

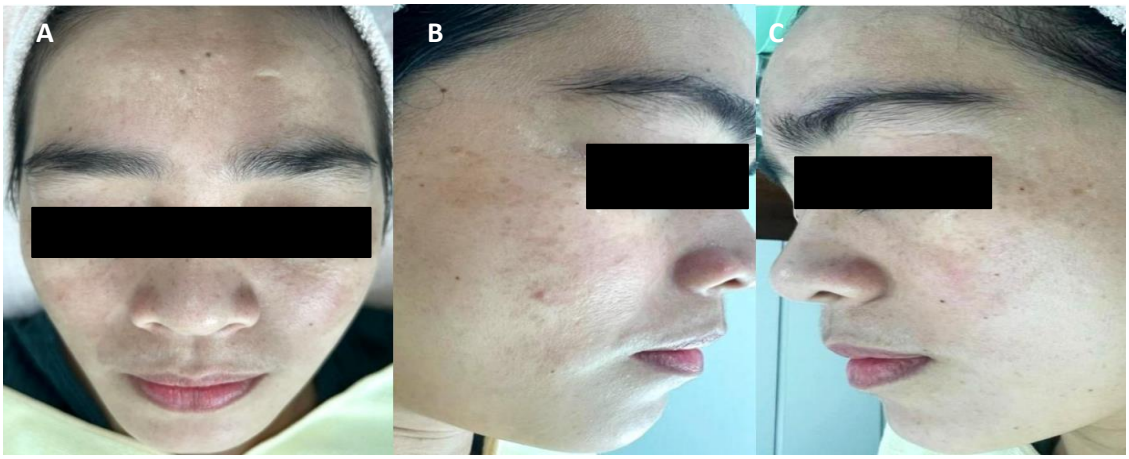

Figure 2: Post-treatment photographs (A: frontal view, B: right lateral view, C: left lateral view)

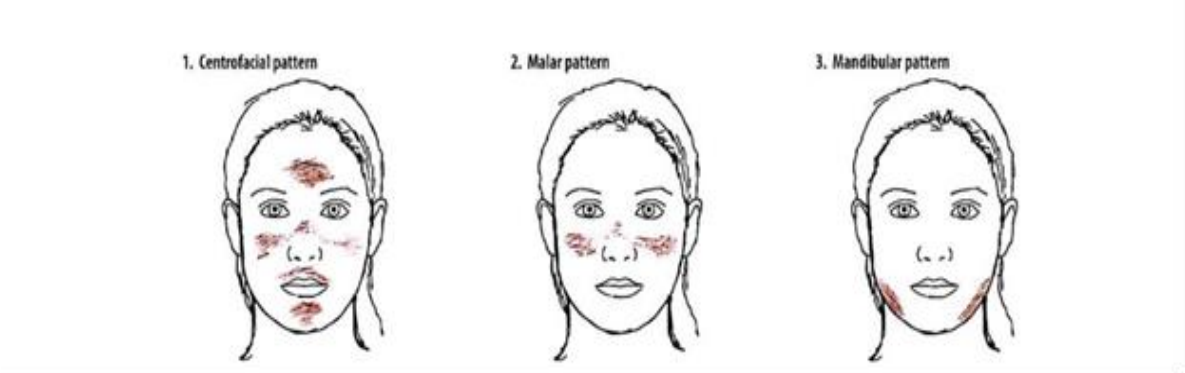

Figure 3: Pattern of Melasma

Table 1: shows the total MASI score of 34 before initiating treatment and down to 11 after 3 sessions of laser. The MASI score has decreased by 67%, on average.

Area (A) of involvement	MASI score	Before Treatment	After Treatment
Forehead	0.3×A(D+H)+	10.5	4.8
Left Malar	0.3×A(D+H)+	6.3	1.8
Right Malar	0.3×A(D+H)+	6.3	1.8
Chin	0.1 x (A (D+H)+	10.8	2.4
Total score (roundup)		34	11

Table 2: Melasma Area and Severity Index score

	0	1	2	3	4	5	6
Darkness of pigment (D): Severity scale (scale 0-4)	None	Slight	Moderate	Marked	Very marked		
Homogeneity of pigment (H): (scale 0-4)	No pigment	Specks	<2 cm patches	>2cm patches	Homogenous		
Surface area involved (A)		<10%	10%-29%	30%-49%	50%-69%	70-89%	90%-100%
Site involved	Forehead	Rt. malar	Lt. malar	chin			
MELASMA AREA (scale 1-6) MA							
Multiplication factor (MF)	0.3	0.3	0.3	0.1			
MA x MF						Total area (A)	

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believed to be overactive in function and easily stimulated. The efficacy of Q-switched laser treatment for pigmentary lesions is based on the theory of selective photo-thermolysis. Evidence showed that low-fluence 1064-nm Q Switched Nd:YAG laser was an effective therapy treating melasma through subcellular-selective photo-thermolysis. The low fluence-mode application of the 1064-nm QS Nd:YAG laser is now a widely used therapy for melasma without serious side effects , especially in Asians.

As per recent studies by Niwat Polnikorn (1998)[10] regarding the efficacy and safety of the Erbium (ER): YAG laser used in the treatment of Asian skin. It was concluded that significant improvement was noted in all individuals in the study. Shorter periods for re-epithelization and erythemaduration were noted when compared to previously reported results following carbon dioxide laser resurfacing and hence strengthening the use of YAG lasers as a safe and effective in the treatment of Asian skin.

Regardless, it is important to understand that while the use of the 1064-nm QS Nd:YAG laser is widely used in the treatment of melasma, side effects and complications of treatment are common.

However, the most documented complications were not serious. As investigated by Wattanakrai (2010)[11], in his study regarding the effectiveness and safety of the (QS-Nd:YAG) laser treatment . He postulated that among the 22 patients in his study who underwent five sessions at 1-week intervals. He noted a significant improvement of melasma from baseline with an improvement of 75.9% of mMASI score. However, during follow-up, four of 22 patients developed rebound hyperpigmentation, and all patients had recurrence of melasma. It was then concluded that the QS-Nd:YAG laser only provided temporary improvement with common complications such as hypopigmentation, melasma recurrence, and rebound hyperpigmentation.

Hence it is important to note that most treatments of Melasma range from cases to case. It is then valuable to identify those high-risk individuals during history taking in determining the severity and likelihood of these side-effects and complications during treatment. Pre-treatment care has proven to be very effective in reducing the risk of side effects and complications.

In a recent study by Jeong et al (2010)[12], who compared the clinical efficacy and adverse effects of low fluence Q switched Nd:YAG (1064 nm) laser when performed before and after treatment with topical triple combination creams (TCCs). The author concluded that pre-treatment with TCCs was more effective as this decreases melanin production before laser injury, hence chances of post inflammatory hyper-pigmentations are reduced and the melasma is improved. If TCC is used after laser treatment, melanin is being produced at full capacity, hence increasing chances of PIH and slowing improvement of melasma. It was recommended that medical treatment for hyperpigmentation for at least 8 weeks before laser treatment to achieve optimal results.

In conclusion, the overall use of the 064-nm QS Nd:YAG laser proved effective in the treatment of Melasma amongst Asians. However, it is important to get proper history taking prior treatment in predicting the risk and complications of the procedure. Pre-treatment and post treatment care has proven to be valuable in increasing the effectiveness of this treatment followed with compliance in subsequent visits to the clinic for review.

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